FISH/MSL F676 AND BIOL F670: AQUATIC FOOD WEB ECOLOGY
FALL 2022

Prerequisites: Graduate standing.

Credits: 3 credits (2 lecture, 1 lab)

Meeting Times: 13:00–14:00 Mondays/Fridays (lecture), 13:00–16:00 Wednesdays (lab)
Meeting Location: 201 Irving I (UAF). Zoom option: link

Instructor: Dr. Jeffrey Muehlbauer, 907-474-5773 (Office), jdmuehlbauer@alaska.edu
Office Hours: Mondays/Fridays 2:00 PM–3:00 PM. Or feel free to pop in anytime or schedule a Zoom.

Instructional Method and Accommodations
Class meetings (for now) are anticipated to be held **live and in-person, with Zoom as a backup** for participants who are remote or unable/uncomfortable with meeting in person. This is in part a group discussion-based class; asynchronous/recorded options are not possible.

I will do my best to be flexible and accommodating of everyone's needs to make this a successful class for us all. **Please communicate early and often!** I appreciate all feedback.

We will use Canvas as our Learning Management System to facilitate sharing of course materials.

Course Description
Examines theoretical and applied aspects of aquatic food web ecology, from the ecological processes that give rise to patterns in aquatic communities to the incorporation of trophic interactions into ecosystem-based management. Includes a lectures component focused on peer reviewed studies and a lab component focused on applying concepts with data.

Land Acknowledgment and Course Bias
The University of Alaska Fairbanks' Troth Yeddha' campus is on the traditional homelands of the Lower Tanana Dena. The Juneau College of Fisheries and Ocean Sciences campus is on the traditional lands of the A`akw Kwáan. This course will be taught through the dominant lens of western scientific theory, which has been and continues to be dismissive of Indigenous understanding and traditional ecological knowledge. I acknowledge that there are other, valid approaches to ecological understanding and am working to be more inclusive of these diverse backgrounds and histories in my curriculum.

Reading Materials
No textbook is required. Instead, we will focus on peer-reviewed journal articles, which will be posted on Canvas. These materials are copyrighted and are not to be further duplicated or distributed.

Course Goals
1. To introduce students to concepts, theories, and methods used in the study of food web ecology specific to aquatic ecosystems.
2. To provide students with an understanding of the foundational literature in aquatic food web ecology.
3. To improve student familiarity with aquatic food web ecology techniques and quantitative analysis.
4. To improve student familiarity and confidence in public speaking in a scientific setting and with scientific reading and writing.

Student Learning Outcomes

By the end of the course, students will be able to:

1. Cite formative literature and current themes in aquatic food web ecology.
2. Use literature search tools such as Google Scholar to identify relevant literature and current trends in an aquatic food web ecology research topic of interest.
3. Curate a personal reference library in aquatic food web ecology.
4. Discuss, both orally and in writing, the merits, drawbacks, and significance of individual papers in the peer-reviewed scientific literature.
5. Confidently present and lead scientific paper criticism to a group of colleagues.
6. Apply aquatic food web ecological theory to real-world datasets using analysis in *R* software.
7. Develop novel research questions and propose study designs based on real-world aquatic food web ecology data.
8. Prepare and deliver a scientific conference-style presentation on their own research.
9. Write a paper in the scientific journal style of their choosing on a study they designed and carried out, using analytical tools and topical knowledge on aquatic food web ecology learned in class and lab.

Course Structure

Every week we will discuss content related to one or more formative paper(s) in aquatic food web ecology, which I will try to break up between freshwater and marine ecosystems. We will also utilize current peer-reviewed literature to get a better sense of the current state-of-the-art in the field. Finally, in computer lab we will utilize modeling and other analytical approaches and tools to explore aquatic food web ecology data. Generally, Mondays will be a lecture based on the formative literature, Wednesdays will be a computer lab session, and Fridays will be a class discussion of a recent paper (to be led by a graduate student).

Lectures: Because we do not have a textbook, it is especially important that you do the peer-reviewed literature readings (posted to Canvas) before each lecture. Some of these readings are dense in their description of theory and use of quantitative methods; I want you to have read the materials prior to lecture so we can go over questions as needed. My lectures will build upon this literature and the topics and theory they espouse, but in general please do not expect me to summarize the papers in lecture to the extent that you needn't read them to understand the point.

Discussions: Weekly discussions will be led by graduate students enrolled in the graduate-level listing of this stacked course. All students (undergraduate and graduate) are expected to participate in the discussions. **Graduate students will be expected to lead one class session of discussion, and to choose a relevant, current reading from the peer-reviewed literature that is related to the week's theme for discussion.** This paper will be posted to Canvas at least one week in advance, and all students will be expected to read the paper in advance of class. **The paper you choose needs to be discussed and cleared with me before posting, either by email or in person.** We will divvy up discussion leadership assignments on the first day of class. Depending on enrollment, students may have the opportunity to lead additional class sessions for extra credit.

Labs: We will have a "computer lab" (actually our regular meeting location, with students bringing their own laptops). In these sessions I will provide a dataset used for analysis that is related to the week's topic. Graduate students will be expected to use *R* software. In some instances later in the semester we will utilize additional software as well; specifically *Ecopath with Ecosim* and *R Bioenergetics*, although there may be others. Links to download that specialty software (free) will be posted to Canvas. Students are expected to have the relevant software installed prior to lab, and to bring their laptop to every lab session. **If bringing a laptop presents a hardship, please communicate this to me as soon as possible**.

Course Policies

Attendance: Attendance is mandatory. **Please contact me if you need to miss class** (ideally in advance, but I know sometimes things happen).

Participation: All course participants are expected to actively participate in discussions. I appreciate that we all learn differently. I don't expect you always try to be the loudest or to speak up the most; I do expect you to be engaged and to be willing to share your thoughts and be respectful of others.

Preparedness: Simply put, **do the readings**! Come to class having thought about the major points of the papers, any ideas they formed, any questions they raised in your mind (including "I didn't understand…"), etc. If you're not coming to class prepared for discussion, class will be worse for us all.

Respect: All participants are expected to always treat one another with respect. **Our class discussions will be more robust if we can build the trust to freely share our thoughts**. Healthy criticism of ideas is encouraged; criticism of individuals is intolerable. Bullying, harassment, hostility, and similar misbehavior have no place in our classroom nor anywhere else in science.

Academic Honesty: The goal of this course is to foster learning; academic dishonesty is anathema to that and will be taken extremely seriously. All course participants are expected to be familiar with and to adhere to UAF's Student Code of Conduct (https://uaf.edu/csrr/student-conduct). Of particular note to this course:

- Plagiarism, which is the attribution of someone else's work as your own, will result in an automate grade of 0 on the assignment in question, and potential further actions including and up to expulsion from UAF. Plagiarism includes not only written work but also content delivered on slides or in our structured discussions. You are encouraged (and often will be required) to cite information from other colleagues and from the literature, but you must provide proper attribution when doing so. Copying content verbatim is never acceptable without quotations, but attribution goes beyond that. This can include, for example, using quotes to exactly copy content from a source ("*Ich bin ein berliner*", Kennedy 1963), a paraphrased statement with a citation (Kennedy, in a 1963 speech, attempted to convey his empathy for Berlin's residents), or a named attribution in verbal discussion (President Kennedy gave a speech in 1963 about this subject).

- Working in groups will often be encouraged, and I will be clear when this is and is not allowed. In all other cases it is not. In all cases, even when group work is allowed, assignments, presentations, and other products submitted for a grade must be uniquely your own and must reflect your own thought processes. For example, I expect analyses during lab exercises to often be done in collaboration with others as we work through code, but I also expect the report you submit based on those exercises to be your own and not a near-copy of someone else's.

- "Double dipping" by using work for credit from another course, past or present, in this course (or vice versa) is considered academic dishonesty. I understand that students often have a specific focus or interest and that to some extent overlap between courses is expected. In this context, reinterpretation of analyses and research topics may be acceptable, but such work needs to be distinctly different from work in a different course and consist of wholly new analyses and interpretations. I encourage you to discuss any possible course work overlap with me in advance.

Infractions against these policies (both specifically as listed here and broadly as listed in the UAF Student Code of Conduct) will result at a minimum in a grade of 0 on the assignment and potential further disciplinary actions including a failing grade in the course and expulsion from the university.

Evaluation

Assignment	# assignments	Percent of grade
Participation	10	10%
Discussion Leadership	1	10%
Paper Analysis	10	10%
Lab Exercise	12	15%
Final Project Proposal	1	15%
Final Paper	1	25%
Final Presentation	1	15%

Participation: Come to class discussions having read the paper, and be engaged in discussion. At a minimum I expect you to speak up at least once per class. **We have 12 Wednesday discussions; I will grade you (pass/fail) on the best 10**. This means you can miss up to two without penalty, and perfect attendance gives you an opportunity for a little extra credit.

Discussion Leadership: For the Friday discussion class you lead, be prepared to lead an hour of discussion on the paper you chose. You can use Powerpoint slides and introduce ideas, just have an open-format chat with the class, or anything else of your choosing. **You are required to discuss papers and topics for your section with me in advance, and are required to send me the relevant paper to read at least a week in advance for me to post on Canvas**.

Paper Analysis: For the 10 Fridays labeled "Graduate student leads", you will write a 1-page analysis of that day's paper. These are intended to be of use to you as an annotated bibliography, so there are no rigid format requirements. In general, they should convey the take-home point of the paper, any novel methods or results, strengths/weaknesses of the study, and any questions reading the paper raised. **Paper analyses are due on Canvas at the start of the relevant discussion**.

Lab Exercises: Each week in lab we will have a new assignment based on that week's topic. In many cases you should be able to complete much of the exercise in lab. Exercises will be graded on completeness (you did the assignment thoughtfully) more than correctness (you did it exactly the way I would have); in most cases, there are multiple analysis paths you can take and my goal is to introduce you to concepts rather than prescribe outcomes. Rubrics for lab exercises will vary week-to-week depending on the exercise and will be posted to Canvas in advance of class. Lab exercises will be predominantly *R*-based and will generally involve working up an analysis on an existing dataset from a published paper to answer a hypothesis about aquatic food webs. The primary goals of these exercises will be to familiarize you with using specialty packages available in *R* for foodweb analysis, and to give you practice with the format of writing scientific papers in standard format. **Lab exercises are due on Canvas prior to lab the next week**.

Final Project: You will carry out a final project on an aquatic food web ecology project of your choosing. This can be directly related to topics covered in our class and to lab exercises, or it can be entirely new. My hope is that you will do something that directly benefits your thesis chapters.

 The final project proposal is due in lab on Week 9 and we devote lab in Week 7 to working on these proposals. However, you are highly encouraged to reach out to me to discuss ideas before that point! The project proposal will be a prospectus (a few pages) that outlines your goals and objectives, hypotheses, data requirements, proposed analyses, expected outcomes, significance of the work, and key references.

 The Final project paper will be a journal-style scientific paper in which you write up the results of your study, including Abstract, Introduction, Methods, Results, Discussion, and Literature Cited (see grading rubric, below). **The final paper will be due on the last day of finals week.**

 The Final presentation will be a presentation of your final project, in scientific conference style format. It is expected to be about 15 minutes long, depending on course enrollment and to be delivered by *Powerpoint* (see grading rubric, below). **We will have final presentations on the last week of class.**

Final Project Paper Grading Rubric (25 points possible, each point = 1% of course grade)

Writing (5 points): Paper reads well, without typographical or grammatical errors. Flows logically through each section and from one paragraph to the next. Includes a "gap statement" that underscores the novelty of the research. Uses topic sentences.

Format (5 points): Paper looks like a manuscript to be submitted for peer review at a journal, with style of your choosing but applied consistently and containing at least the following: line numbers, title page (title, authors and affiliations, running head, key words), Abstract, Introduction, Methods, Results, Discussion, Acknowledgements, References, Figure legends, Tables, and Figures. At least 20 pages, inclusive of everything below (in double-spaced Times New Roman 12pt or similar). Uses in-text citations and carefully formats references consistently.

Abstract (1 point): Succinctly describe the motivation for the study, information/knowledge gaps, study design, key results, and implications for the field. 300 words or less.

Literature cited (2 points): Cite relevant literature, particularly in the Introduction (as a review of what is known about the subject) and in the Discussion (in synthesizing your results and their importance in the context of the field). Cite at least 20 references.

Methods (2 points): Provide readers with enough information to replicate your study if desired. Study site (if relevant) is described, as are sampling dates/times, collection methods, lab approaches, and analytical tools/software/approaches used. If there were any limitations to the sampling design, that is described too.

Interpretation of Results (5 points): Results are presented (generally in Results section) in such a way that important patterns are described, then are interpreted (generally in Discussion section) in the context of the hypotheses being tested, their meaning to the field, any implications for management. Describe any next steps that could be taken to further the research.

Tables and Figures (5 points): Tables and Figures are of professional quality, designed to be readable at ~3.5" size, and are of appropriate quantity for a publication (generally ~5 total, highly flexible). Figures also contribute meaningfully to the narrative points of the paper and facilitate interpretation of the points being made in the text.

Final Presentation Grading Rubric (15 points possible, each point = 1% of course grade)

Context (2 points): Discuss the importance of your study, tie in the relevant literature for context.

Hypotheses (2 points): Articulate hypotheses you tested, in a null/alternative hypothesis framework.

Methods (2 points): Describe data collection, tools, and analyses you used to carry out the study.

Results (2 points): Present journal-quality figures and explain their importance.

Discussion/Conclusions (2 points): Interpret and explain the meaning of the results in the broader context of the literature, and how your study advances the field.

Delivery (5 points): Presentation is given confidently, with well-formatted slides to convey the content and practiced oral delivery (few "umms"!), and keeps to time limit of 12 minutes, plus 3 minutes for Q&A (time limit subject to change depending on enrollment).

Course Grading

Overall grading for the course will be on the typical +/- scale, as follows (in percentages):

90-100: A ($\leq$ 92.9: A-, $\geq$ 97: A+)
80-89.9: B ($\leq$ 82.9: B-, $\geq$ 87: B+)
70-79.9: C ($\leq$ 72.9: C-, $\geq$ 77: C+)
60-69.9: D ($\leq$ 62.9: D-, $\geq$ 67: D+)
   < 60: F

I will follow the University of Alaska Fairbanks Incomplete Grade Policy: "The letter "I" (Incomplete) is a temporary grade used to indicate that the student has satisfactorily completed (C or better) the majority of work in a course but for personal reasons beyond the student's control, such as sickness, has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an "I" grade."

WEEKLY SCHEDULE *(subject to change)*

Week	Topic	Monday Lecture	Wednesday Lab Activity (Lab Assignment #)	Friday Discussion
1 8/29-9/2	What are food webs? Why aquatic food webs?	Intro to course	Intro to software. "Horrendogram" food web visual analysis. (#1: Analyze Tuesday Lake food web- cheddar in R)	Lindeman 1942 (Muehlbauer leads)
2 9/5-9/9	Trophic position, food chain length, diversity	*No class (Labor Day)*	Food chain length using stable isotopes. (#2: Sensitivity analysis of trophic position based on Post 2002: can you make a mussel a top predator?)	Paine 1980 (Muehlbauer leads)
3 9/12-9/16	Turnover, Production	Benke & Wallace 1980	Resolving the Allen paradox of fish production using secondary production measurements. (#3: Replicate feeding analysis by Huryn 1996 using R)	Graduate student leads
4 9/19-9/23	Resource partitioning	Connell 1961	Path analysis in food webs. (#4: Compute interaction strengths based on available food web data--you pick the ecosystem)	Graduate student leads
5 9/26-9/30	Predation, size selection	Brooks & Dodson 1965	Gape limitation analysis, eco-evolutionary feedbacks (#5: Predict ontogenetic feeding shifts based on gape using Schmitt & Holbrook 1984).	Graduate student leads
6 10/3-10/7	Predator-Prey Dynamics, indirect effects	Wootton 1994	Lotka-Volterra models in aquatic ecosystems. (#6: Solve Lotka-Volterra models using deSolve in R)	Graduate student leads
8 10/10-10/14	Indigenous People's week: Non-western perspectives on aquatic food webs	TBA	Work on project proposal	TBA
7 10/17-10/21	Foraging modes	Werner & Hall 1974	Optimal foraging. (#7: Do blue whales optimally forage? Using Doniol-Valcroze et al. 2011).	Graduate student leads
9 10/24-10/28	Bioenergetics	Kitchell 1977	** *Project Proposals Due* ** Bioenergetics analysis. (#8: Fish Bioenergetics 4.0 in R. Use package data)	Graduate student leads
10 10/31-11/4	Halloween week: Cannibals, sharks, and the legend of functional feeding groups	Polis et al. 1989	Ecopath with Ecosim. (#9: Risk analysis to sharks based on Rupp & Bornatowski 2021)	Graduate student leads
11 11/7-11/11	Fishing effects	Jackson et al. 2001	Functional feeding group analysis. (#10: Ordination using vegan in R using Muehlbauer's shoreline dataset)	Graduate student leads
12 11/14-11/18	Ecological subsidies	Nakano & Murakami 2001	Determining food sources using stable isotopes. (#11: Bayesian mixing models with SIAR using Muehlbauer's subsidies dataset)	Graduate student leads
13 11/21-11/25	Thanksgiving week: Thankful for compelling narratives	Olson 2019 Work on Final Project	*No class (Thanksgiving)*	*No class (Thanksgiving)*
14 11/28-12/2	Trophic cascades, top-down vs. bottom-up control	Estes 1998	Top-down control analysis (#12: 3-vs. 4-level food web analysis using Muehlbauer's trout removal dataset)	Graduate student leads
15 12/5-12/9	Wrap up	Work on Final Project presentations	Final Project presentations	Final Project presentations
16 12/12-12/16	*Finals week. No class. Final Project paper due on Canvas by 17:00 on Friday, 12/16*			

COVID-19 statement: Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website:
https://sites.google.com/alaska.edu/coronavirus/uaf?authuser=0
Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.

Student protections statement: UAF embraces and grows a culture of respect, diversity, inclusion, and caring. Students at this university are protected against sexual harassment and discrimination (Title IX). Faculty members are designated as responsible employees which means they are required to report sexual misconduct. Graduate teaching assistants do not share the same reporting obligations. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: https://catalog.uaf.edu/academics-regulations/students-rights-responsibilities/.

Disability services statement: I will work with the Office of Disability Services to provide reasonable accommodation to students with disabilities.

Student Academic Support:
- Speaking Center (907-474-5470, uaf-speakingcenter@alaska.edu, Gruening 507)
- Writing Center (907-474-5314, uaf-writing-center@alaska.edu, Gruening 8th floor)
- UAF Math Services, uafmathstatlab@gmail.com, Chapman Building (for math fee paying students only)
- Developmental Math Lab, Gruening 406
- The Debbie Moses Learning Center at CTC (907-455-2860, 604 Barnette St, Room 120, https://www.ctc.uaf.edu/student-services/student-success-center/)
- For more information and resources, please see the Academic Advising Resource List (https://www.uaf.edu/advising/lr/SKM_364e19011717281.pdf)

Student Resources:
- Disability Services (907-474-5655, uaf-disability-services@alaska.edu, Whitaker 208)
- Student Health & Counseling **[6 free counseling sessions]** (907-474-7043, https://www.uaf.edu/chc/appointments.php, Whitaker 203)
- Center for Student Rights and Responsibilities (907-474-7317, uaf-studentrights@alaska.edu, Eielson 110)
- Associated Students of the University of Alaska Fairbanks (ASUAF) or ASUAF Student Government (907-474-7355, asuaf.office@alaska.edu, Wood Center 119)

Nondiscrimination statement: The University of Alaska is an affirmative action/equal opportunity employer and educational institution. The University of Alaska does not discriminate on the basis of race, religion, color, national origin, citizenship, age, sex, physical or mental disability, status as a protected veteran, marital status, changes in marital status, pregnancy, childbirth or related medical conditions, parenthood, sexual orientation, gender identity, political affiliation or belief, genetic information, or other legally protected status. The University's commitment to nondiscrimination, including against sex discrimination, applies to students, employees, and applicants for admission and employment. Contact information, applicable laws, and complaint procedures are included on UA's statement of nondiscrimination available at www.alaska.edu/nondiscrimination. For more information, contact: UAF Department of Equity and Compliance

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Additional syllabi statement for courses including off-campus programs and research activities:
University Sponsored Off-Campus Programs and Research Activities
We want you to know that:

1. UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: www.alaska.edu/nondiscrimination.
2. Incidents can be reported to your university's Equity and Compliance office (listed below) or online reporting portal. University of Alaska takes immediate, effective, and appropriate action to respond to reported acts of discrimination and harassment.
3. There are supportive measures available to individuals that may have experienced discrimination.
4. University of Alaska's Board of Regents' Policy & University Regulations (UA BoR P&R) 01.02.020 Nondiscrimination and 01.04 Sex and Gender-Based Discrimination Under Title IX, go to: http://alaska.edu/bor/policy-regulations/.
5. UA BoR P&R apply at all university owned or operated sites, university sanctioned events, clinical sites and during all academic or research related travel that are university sponsored.

For further information on your rights and resources click here.

Emergency notification plan
Students will receive emergency notifications via phone or email. Please check your UAOnline account to confirm your emergency notification settings. For more information, please refer to the Student Handbook. In cases where you do not have access to your devices, your instructor will take responsibility to relay any emergency notifications.

Extended absence policy
The university of Alaska Fairbanks recognizes that students may need to miss more classes than allowed by a particular instructor as specified in course policies. Students may need to miss class and/or course work for a variety of reasons, including, but not limited to: bereavement, personal illness or injury, serious illness of a friend, family member or loved one, military obligations, jury service, and other emergency or obligatory situations. For more information, go to the Students Handbook or the Center for Student Rights and Responsibilities.